CONDENSED MATTER SCIENCES SEMINAR

Professor Edwin Huang

University of Notre Dame

Host

Dr Hitesh Changlani

Title

The Hubbard model: what we know from finite-temperature numerics

Friday, April 26th, 2024

1st Floor – B101

15:00-16:00

Abstract

The Hubbard model is the paradigmatic model of correlated electrons on a lattice. Its realization on the 2d square lattice has been studied intensely for its perceived relevance to the physics of cuprate superconductors. Although the model has no known analytic solution, there has been significant progress in understanding the essential physics of the model over the past several years through advances in numerical simulation techniques. In this talk I will discuss the current situation concerning our knowledge of the Hubbard model. I will focus on the finite temperature properties we have deduced from exact quantum Monte Carlo calculations, including the behavior of stripes, superconductivity, transport properties, and spectroscopic properties.

Bio

Prof. Huang's research utilizes a combination of large-scale numerical and analytical techniques to study the emergent properties of strongly correlated quantum materials through model calculations and comparisons against experimental spectroscopy.

Traffic, Edwin Huang describes, isn't dissimilar to condensed matter physics. His research uses numerical and analytical techniques to study properties of quantum materials—and that's where his correlation with traffic begins, with the "many-body phenomena." A single car or a few cars will go the speed limit, and operate independently, but when there are many cars on the road, the entire behavior of the traffic changes. They slow down and speed up for no reason. "We try to study the same thing with electrons in materials, how behavior changes as a function of electron density strain on a system, or temperature change, for example," Huang said. Changing these parameters can result in different phases of metals: superconductors, magnets, and materials with other properties. Within his field, Huang focuses on correlated electron systems with numerical algorithms to simulate these systems.